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Assessment of Soil Fertility and Suitability for Some Crops Using Gis and Remote Sensing Techniques

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Abstract

The study area is about 95311ha, it was implemented as a case study in the Nile Delta, where the indicators of soil fertility, suitability and capacity were examined. The area includes the centers of Kafr El-Sheikh, Desouq, Qaleen and Fouh in the Kafr El-Sheikh Governorate, which is between the longitudes of 30º30` to 31º02`E, and between the two latitudes 31º00` to 31º 20` north. Ten soil profiles were dug and classified as *TypicAquisalids, TypicNatrargids, TypicTorrifluvents, and VerticTorrifluvents*, represent 1.60%, 1.73%, 34.04% and 53.38% of the total area, respectively. Results of Soil Fertility Index showed that 34.95%, 45.13%, 5.20 and 5.46% of the area were very high, high, moderate and low fertility, respectively. The results of the soil suitability classification indicate that, the most units fall under the moderately suitable class (S2) which represents 54.76% of the total area (52193 ha.). The highly suitable class (S1) represents 5.05% of the total area (4813ha). About 30.93% of the study area (29476 ha.) while marginally class (S3) and those areas have adverse physical and chemical properties of the soil. The results found that the area is suitable for field crops. The study of the factors affecting the crop composition showed that the natural and human factors had a clear effect on the crop complex in the study area. The study area had suitable climatic conditions for the cultivation and growth of most crops in their different seasons.

Keywords: Land suitability; Land forms; Soil data; spatial analysis; Land use planning

Introduction

The land is the first natural wealth that provides food for millions of people, so it becomes clear the importance of caring for the land and knowing its fertility level, which is increasing day by day **(Dumanski et al., 2010; Mohana e al., 2009)**. The agricultural sector has been the mainstay of Egypt over the years, as it contains great development energies that help push development efforts to launch development to achieve economic and social development goals to raise the standard of living of the population in Egypt. Studies of sustainable agricultural development in ancient agricultural areas such as the delta are one of the important ways to increase the vertical agricultural area to raise the efficiency and capacity of societies, as these agricultural lands are spread in wide and different areas, both in the delta or the valley in the Arab Republic of Egypt **(AbdelRahman et al., 2018; AbdelRahman and Tahoun, 2019; AbdelRahman and Arafat, 2020; Ali et al, 2020; Shalaby et al, 2017)**. These lands are also characterized by a dry climate, which helps to oxidize organic water quickly, and therefore its content of organic matter is low due to the high temperature in it and the lack of precipitation in it or scarcity. Therefore, the need to preserve this agricultural area and raise its efficiency requires a study of the fertility of the lands for these areas, as well as their suitability for the types of crops that correspond to the climatic conditions and the available irrigation conditions. **(AbdelRahman et al. 2018).** Therefore, the desired goal of the study is to identify the properties of the natural, chemical, and biological soils related to the fertility of the land directly or indirectly, and its relationship to the suitability of the soil for different crops.

The turbulent population increase requires working to raise the efficiency of the agricultural field to meet the increase in demand for food commodities (Ahmed, 2016). Worldwide, agriculture has proven the potential to increase food supplies **(Dent, 1993).** And many of the cultivation land has become unsuitable for food production **(Verheye, 2008)**. Agriculture is one of the largest sectors of the Egyptian economy **(CAPMAS, 2012).** In Egypt, lands resources face threats from land deterioration and very rapidly of people number, so conservation of the natural resources is essential for sustainable land management. **(Hamza and Mason, 2004).**

The state has a strategic direction in preserving and maintaining agricultural lands and raising the productive return from them, which highlights the importance of evaluating soil fertility for optimal agricultural use using remote sensing techniques and geographic information systems. Soil fertility status plays an important role in nutrient management in modern agriculture **(AbdelRahman et al. 2016a,AbdelRahman et al.**

2016b, and AbdelRahman et al. 2018) Crop production appears to be strongly affected by appropriate site-specific fertilizer management **(AbdelRahman and Tahoun, 2018).**

Land suitability assessment is essential for improvement land productivity and development a sustainable land management **(Taghizadeh-Mehrjardi et al., 2020).** Land suitability maps provide the necessary information for agricultural planners and decreasing land degradation for sustainable land use **(Bagherzadeh and Daneshvar, 2014).** The wheat crop production in Egypt is one of the crops which tolerate different types of stress and is considered the important crop in the winter season **(FAO, 2005).**

To achieve the objectives of the study, the geographical data of the agricultural development elements in the area below will be collected, and then the effective employment of agricultural resources among the various agricultural uses, to produce fertility and suitability maps.

Materials and Methods

Study area description.

The study area is about **95311**hectares. It was implemented as a case study in the Egyptian Delta, where the indicators of soil fertility, suitability and capacity were examined. As shown in Fig(1), the area includes the centers of Kafr El-Sheikh, Desouq, Qaleen and Fouh in the Kafr El-Sheikh Governorate, which is between the longitudes of 30º30` to 31º02`E, and between the two latitudes 31º00` to 31º 20` north.

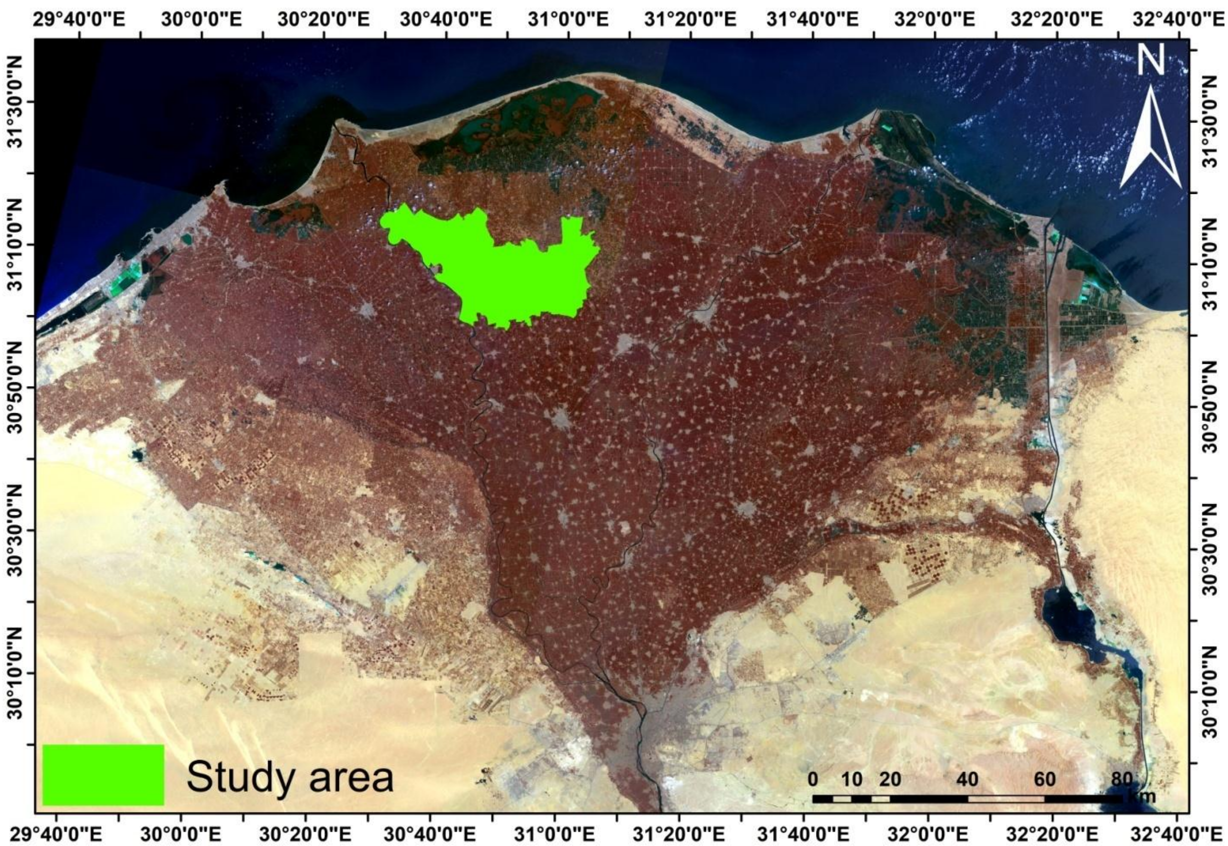

Fig. 1. Location of the study area

Data acquisition

Soil survey and sampling were conducted by Soil Survey Manual (2017). A detailed morphological description of soil profiles was recorded based on the guidelines of **FAO (2006).** Soil samples (Fig. 2) were taken from different layer of soil profilesand to represent the identified mapping units, the locations of these profiles were defined by using the GPS. Samples were taken from the same coverage most of the landform units.Soil samples were air-dried in the laboratory ground and sieved through a 2 mm sieve. Particle size distribution was determined according to **USDA (2004).**Electric conductivity (EC), soluble cations and anions, organic matter, pH, exchangeable sodium percent and macro nutrients (NPK) were determined according to **Bandyopadhyay (2007).**The soils were classified according to **USDA(2014).**

Satellite Data:

Digital image processing of Landsat-8 OLI imagein 2021 was executed using ENVI 5.2 and the ArcGIS 10.2software's. The digital image processing included bad lines manipulation by filling gaps module designed using IDL language, data calibration to radiance according to **Lillesand** and **Kiefer (2007).**The Landsat-8 OLI image and the DEM were used to obtain the physiographic units and establish a soil database **(Dobos et al., 2000).** This study used the GIS for assessing and mapping of soil fertility index (SFI) in the investigated area.

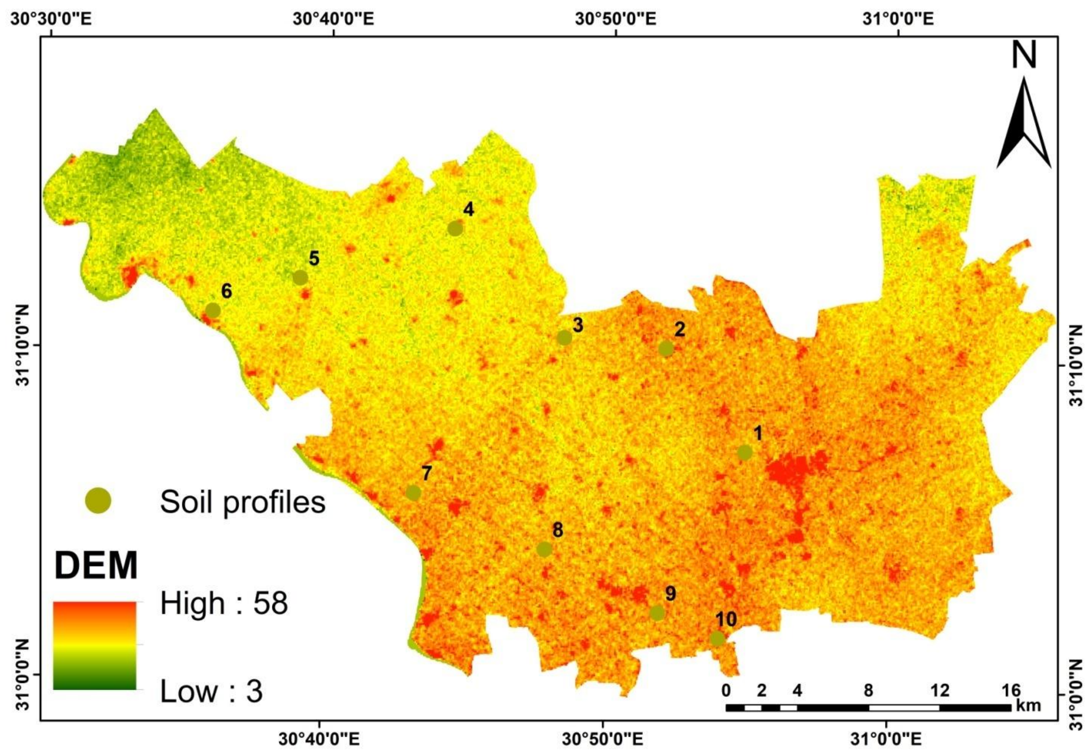

Fig. 2. Location of soil profiles over DEM of the study area

Soil Fertility Index (SFI) classification.

Fig (3) shows the different steps in the research methods that were implemented. Soil fertility mapping shows the best distribution of soil nutrients **(Mukashema, 2007).** This may benefit agricultural land improvement and productivity. There are many factors that determine soil fertility. This depends on the soil classification. In general, the soil fertility evaluated depends on several factors such as texture, organic matter, soil pH, electrical conductivity, total calcium carbonate, N, P, and K, and available micronutrients.

$$SFI = \left(\sum^{n} i = 1^{s} {}^{j}/_{n}\right) \times 10 ....$$ **(Andrews et al., 2004).**

*Sj*is the indicator index value which scored for probability and n is the number of MSFI's indicators. The SFI value was multiplied by 10 to make results more amenable for producers and other potential users **(Andrews et al., 2003).**

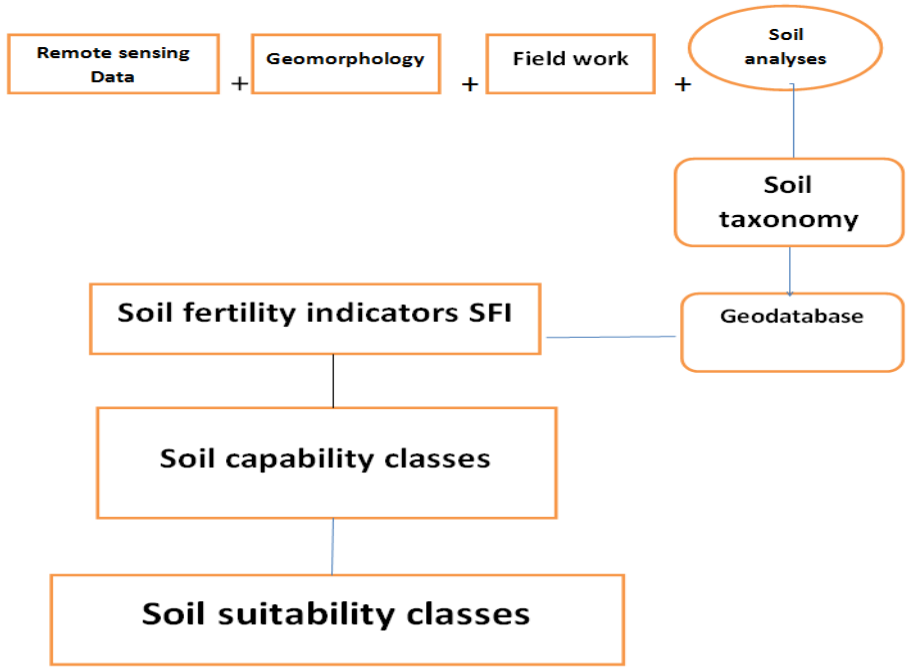

Fig. 3. Flow chart showing a summary of SFI and suitability classification

Geomorphologic units of the studied area:

The main geomorphologic units in the study area can be observed into one landscape (flood plain) as shown in Fig (4).The flood plain is the main landscape in the present area and covering 45986 ha. (90.74% of the total area). Flood plain which includes landforms of river levees, overflow mantles, overflow basins, decantation basins and river terraces (moderately high & low), with areas of about **1650**, **10777**, **19192, 32782**and **22082**ha., respectively Results indicated that the main soil sub great soil groups in the study area according to **USDA (2014)** are *TypicAquisalids, TypicNatrargids, TypicTorrifluvents, and VerticTorrifluvents*. These sub great groups represent **1.60**%, **1.73**%, **34.04**% and **53.38**% of the total area, respectively, as shown in Table 5 and Fig 3.

Table 1. Geomorphologic units, percentages of the total area and representative soil profiles.

Landscape	Landform	Area in ha.	Area (%)
Flood plain	**Decantation basins**	**32782**	**34.39**
	Overflow basins	**19192**	**20.14**
	Overflow mantle	**10777**	**11.31**
	River levees	**1650**	**1.73**
	River terraces	**22082**	**23.17**
	Fish Bonds	**222**	**0.23**
	Urban	**8607**	**9.03**
	Total area	**95311**	**100.00**

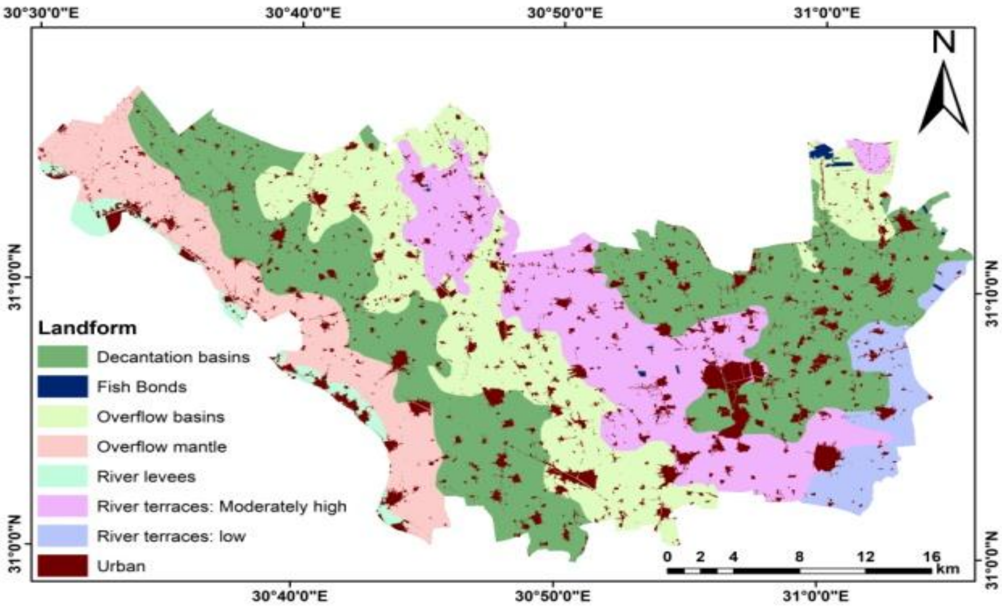

Fig. 4: Geomorphologic map of the studied area, after Darwish and Abdel Kawy (2008)

Table 2. Area of the taxonomic units

Soil Taxonomy	Area in km2	Area (%)
TypicAquisalids	**1524**	**1.60**
TypicNatrargids	**1645**	**1.73**
TypicTorrifluvents	**32440**	**34.04**
VerticTorrifluvents	**50874**	**53.38**
Fish Bonds	**222**	**0.23**
Urban	**8607**	**9.03**
Total area	**95311**	**100.00**

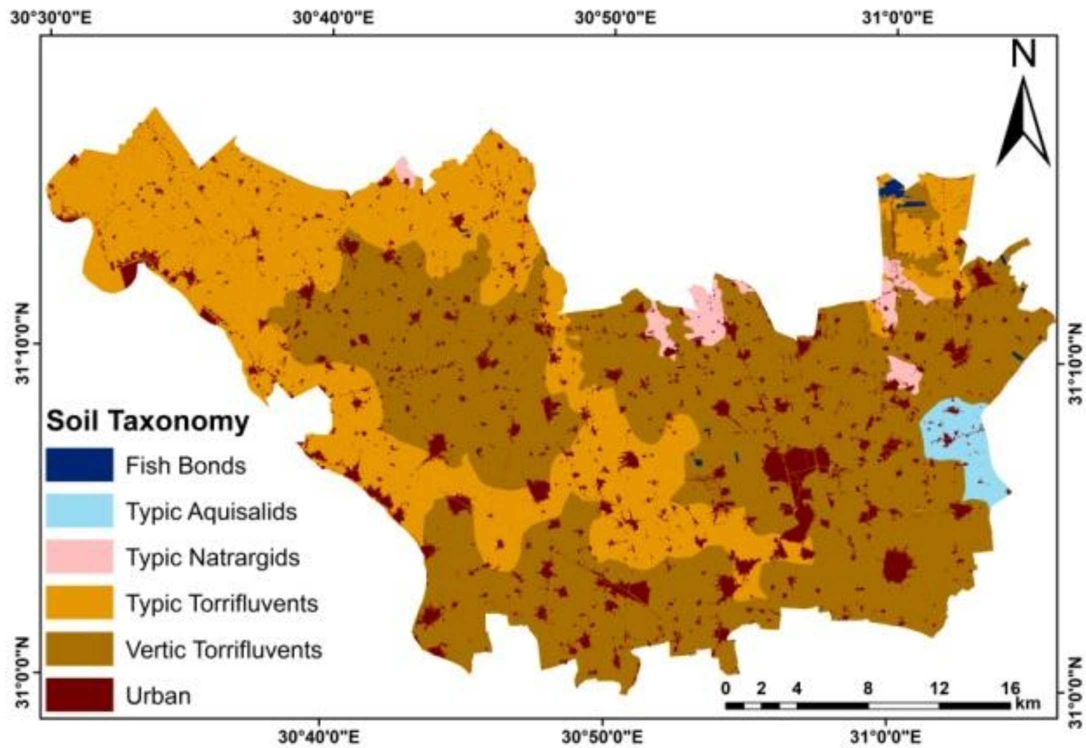

Fig. 5: Soils of the study area.

Soils and its fertility status:

The results listed in Tables 1, 2 and 3 show some of the results of soil laboratory analyzes of the values of different soil layer samples. Fig (6) shows an indication of the extent of plant production that the soil can provide under the conditions of the present soil characteristics. Soil fertility has been divided into four levels: very high fertile, high fertile, medium fertile and low fertile soils. Where this division was made based on the division of soil indicators into three levels: physical, chemical and biological. Results of SFI showed that **34.95**%, **45.13**%, **5.20** and **5.46**% of the area were very high, and high, moderate and low fertility, respectively, as shown in Table 6.

The high soil fertility in the southern part of the study area is attributed to the physical fertility due to the texture, structure and depth of the soil. Its chemical fertility is also high because the soil contains the nutrients necessary for the growth of plants. And vital fertility is due to the moderation of the proportion of organic matter.

Table 3. Particle size distribution and CaCO3 for the studied profiles (No. 1 to 10).

Profile No.	Depth cm	C.sand %	F.sand %	T.sand %	Silt %	Clay %	Texture Class	$CaCO_3$ (g kg^{-1})
	0-30	26.39	1.40	27.79	30.00	40.00	Clay loam	0.20
1	30-60	21.46	1.70	23.16	35.00	40.00	Clay loam	1.6.0
	60-100	21.25	2.10	23.35	35.00	40.00	Clay loam	1.40
	0-30	21.48	2.10	23.59	35.00	40.00	Clay loam	1.20
2	30-60	31.38	1.80	33.18	25.00	40.00	Clay loam	1.60
	60-100	30.18	2.90	33.08	20.00	45.00	Clay loam	1.40
	0-30	26.06	1.50	27.56	25.00	45.00	Clay	2.20
3	30-60	21.13	1.20	22.33	25.00	50.00	Clay	2.40
	60-100	21.35	1.10	22.45	30.00	45.00	Clay	1.80
	0-30	32.19	1.40	33.64	20.00	45.00	Clay	1.20
4	30-60	11.43	1.20	12.63	35.00	50.00	Clay	2.20
	60-100	15.65	1.30	00.17	30.00	55.00	Clay	2.80
5	0-30	19.39	3.10	22.49	20.00	55.00	Clay	2.20

	30-60	22.88	3.20	26.08	25.00	45.00	Clay	3.60
	60-100	30.19	2.10	32.29	25.00	40.00	Clay	2.40
	0-30	16.17	0.90	17.07	30.00	50.00	Clay	2.80
6	30-60	20.27	1.20	21.47	30.00	45.00	Clay	3.40
	60-100	25.49	1.70	27.24	25.00	45.00	Clay	2.0
	0-30	31.07	3.40	34.47	20.00	45.00	Clay	1.20
7	30-60	28.54	4.30	32.85	25.00	40.00	Clay	1.80
	60-100	26.18	3.10	29.33	24.00	45.00	Clay	1.40
	0-30	15.71	1.80	17.51	25.00	55.00	Clay	2.20
8	30-60	11.42	1.30	12.72	35.00	50.00	Clay	2.00
	60-100	21.35	1.90	23.25	25.00	50.00	Clay	1.40
	0-30	21.63	1.30	43.57	30.00	45.00	Clay	1.60
9	30-60	21.94	1.80	23.74	25.00	50.00	Clay	1.40
	60-100	21.63	1.40	23.03	30.00	45.00	Clay	1.80
	0-30	16.16	1.70	17.86	35.00	45.00	Clay	2.00
10	30-60	16.22	1.80	18.02	25.00	55.00	Clay	1.80
	60-100	17.51	1.30	18.81	30.00	50.00	Clay	1.00

Table 4. EC, pH, O.M, soluble cations and anions for the studied profiles (No. 1 to 10).

Profile No.	Depth)cm(	EC ds m-1	pH extract 1:2.5)	O.M)g/kg(	Soluble cations (mmolc\ L)				Soluble anions (mmolc\L)			
					Ca2+	**Mg2+**	**Na+**	**K+**	**Co32-**	**Hco3-**	**Cl-**	**So4-2**
	0-30	0.65	7.90	**1.10**	**0.52**	**0.38**	**2.30**	**0.05**	**0.00**	**0.37**	**0.72**	**0.90**
1	30-60	0.70	0..80	**1.10**	**0.79**	**0.28**	**2.38**	**0.05**	**0.00**	**0.66**	**2.25**	**1.07**
	60-100	0.78	0.80	**1.10**	**0.95**	**0.17**	**2.65**	**0.06**	**0.00**	**0.47**	**216**	**1.12**
	0-30	0.65	0.80	**1.20**	**0.57**	**0.63**	**1.97**	**0.06**	**0.00**	**0.34**	**0.44**	**1.20**
	30-60	0.7	7.90	**1.20**	**1.20**	**0.46**	**1.91**	**0.05**	**0.00**	**0.47**	**0.54**	**1.50**
2	60-100	0.84	7.90	**1.20**	**1.10**	**0.56**	**2.46**	**0.07**	**0.00**	**00.5**	**0.74**	**1.65**
	0-30	0.74	7.90	**0.90**	**0.73**	**1.20**	**1.68**	**0.03**	**0.00**	**00.5**	**0.54**	**2.63**
3	30-60	0.85	0.80	**0.90**	**0.73**	**0.72**	**2.74**	**0.04**	**0.00**	**0.43**	**0.98**	**2.82**
	60-100	0.73	0.80	**0.90**	**0.52**	**1.20**	**1.83**	**0.05**	**0.00**	**0.53**	**1.14**	**1.96**
	0-30	0.55	8.10	**0.80**	**0.77**	**0.87**	**1.08**	**0.03**	**0.00**	**0.53**	**1.70**	**0.52**
4	30-60	0.53	7.90	**0.80**	**0.68**	**1.00**	**0.91**	**0.04**	**0.00**	**0.47**	**00.5**	**1.67**
	60-100	0.58	7.90	**0.80**	**0.57**	**0.52**	**1.76**	**0.05**	**0.00**	**0.49**	**0.49**	**1.92**
	0-30	0.98	8.10	**0.90**	**0.83**	**0.92**	**3.10**	**0.05**	**0.00**	**0.65**	**2.10**	**2.15**
5	30-60	0.10	8.10	**0.90**	**0.99**	**0.81**	**3.09**	**0.06**	**0.00**	**0.55**	**2.50**	**1.87**
	60-100	0.87	8.00	**0.9**	**0.47**	**01.2**	**2.62**	**0.03**	**0.00**	**0.56**	**2.25**	**1.52**
6	0-30	0.44	8.00	**1.10**	**0.52**	**0.33**	**1.28**	**0.07**	**0.00**	**0.50**	**1.05**	**0.65**
	30-60	0.43	7.90	**1.10**	**0.48**	**0.17**	**1.45**	**0.06**	**0.00**	**0.54**	**1.02**	**0.59**
	60-100	0.49	7.90	**1.10**	**0.39**	**0.16**	**1.85**	**0.03**	**0.00**	**0.67**	**1.10**	**0.66**
	0-30	0.42	8.10	**1.10**	**0.65**	**0.19**	**1.19**	**0.06**	**0.00**	**0.59**	**0.91**	**0.59**
7	30-60	0.39	0.80	**1.10**	**0.50**	**0.23**	**1.18**	**0.04**	**0.00**	**0.57**	**0.89**	**0.49**
	60-100	0.33	0..80	**1.10**	**0.26**	**0.34**	**00.1**	**0.05**	**0.00**	**0.67**	**0.36**	**0.62**
	0-30	0.32	0.80	**1.30**	**0.47**	**0.48**	**0.63**	**0.02**	**0.00**	**0.46**	**0.49**	**0.65**
8	30-60	0.38	8.10	**1.30**	**0.31**	**0.54**	**1.02**	**0.03**	**0.00**	**0.56**	**0.49**	**0.85**
	60-100	0.38	7.90	**1.30**	**0.52**	**0.58**	**0.79**	**0.01**	**0.00**	**0.58**	**0.44**	**0.88**
	0-30	0.51	7.90	**.950**	**0.73**	**0.47**	**1.29**	**0.05**	**0.00**	**0.49**	**1.27**	**0.78**
9	30-60	0.56	7.80	**.950**	**0.84**	**0.71**	**1.16**	**0.04**	**0.00**	**0.63**	**1.57**	**0.55**
	60-100	0.52	0.80	**.950**	**0.99**	**0.21**	**1.34**	**0.06**	**0.00**	**0.43**	**0.46**	**1.71**
	0-30	0.45	8.10	**1.10**	**0.64**	**0.33**	**1.22**	**0.03**	**0.00**	**0.43**	**1.12**	**0.67**
10	30-60	0.43	7.90	**1.10**	**0.56**	**0.48**	**1.09**	**0.02**	**0.00**	**0.46**	**0.65**	**1.04**
	60-100	0.69	0.80	**1.10**	**0.54**	**0.43**	**2.42**	**0.05**	**0.00**	**0.50**	**0.53**	**2.41**

Table 5. Available macro and micro nutrients for surface soil layersof the studied soil profiles (No. 1 to 10).

Profile No.	Depth (cm)	Macro nutrients (mg kg-1)			Micro nutrients (mg kg-1)			
		N	P	k	fe	Mn	Zn	Cu
1	0-30	22.0	19.0	480.0	27.6	25.1	1.3	4.1
2	0-30	18.0	16.0	460.0	15.8	26.4	1.4	5.8
3	0-30	19.0	14.9	425.0	27.4	28.1	1.8	6.1
4	0-30	18.0	19.4	375.0	21.6	27.6	0.9	4.5
5	0-30	11.0	13.6	390.0	38.1	25.2	1.6	5.6
6	0-30	23.0	13.4	430.0	29.6	23.4	1.2	6.1
7	0-30	21.0	12.9	425.0	29.6	23.4	1.2	6.1
8	0-30	15.0	18.7	415.0	22.3	27.3	0.9	6.3
9	0-30	25.0	15.7	390.0	25.1	28.4	0.9	6.7
10	0-30	21.0	15.9	430.0	22.2	29.7	1.3	5.1

Table 6. SFI classes, and area in the investigated area**.**

Soil Fertility Index (SFI)	Area in ha.	Area (%)
Very High	**33307**	**34.95**
High	**43011**	**45.13**
Low	**5207**	**5.46**
Moderate	**4958**	**5.20**
Fish Bonds	**222**	**0.23**
Urban	**8607**	**9.03**
Total area	**95311**	**100.00**

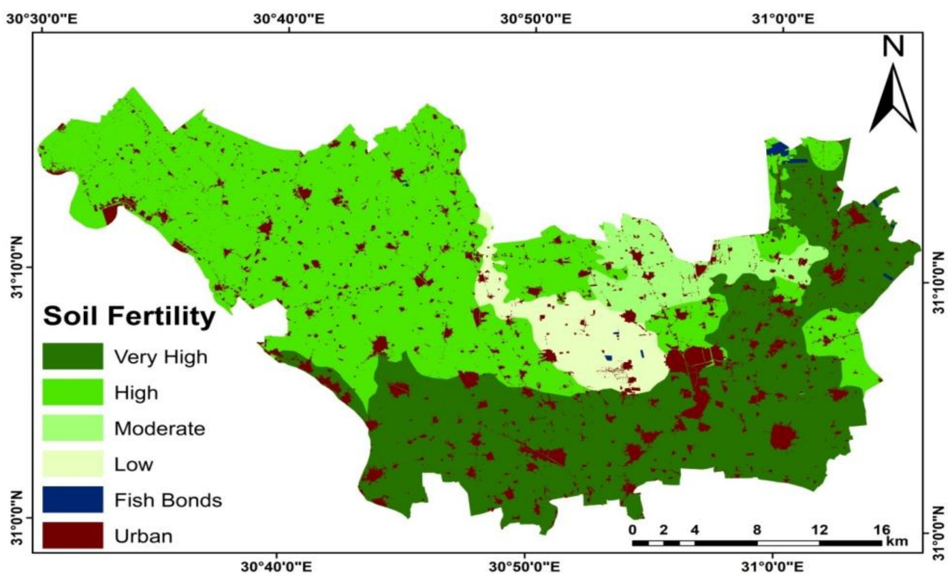

Fig. 6: Soil Fertility Index (SFI).

Land Suitability Classification.

The results of the soil suitability classification for crop production as shown in Table 6 indicate that, the most geomorphologic units of the studied area fall under the highly and moderately classes (S1& S2).It is clear from the production capacity maps and suitability maps, that the crop rotation or crop rotation is the alternation of different crops on a single plot of land. The agricultural cycles are an important element in increasing production and improving soil fertility. This process is beneficial in the lack of depletion of minerals and elements in the soil, because when the land is cultivated with the same crop throughout the year, the consumption of minerals and elements needed by this element will lead to its depletion from the soil, but when crop rotation or agricultural rotation is used, the earth can recover the elements and minerals in the soil. Among the best crop compositions for the study area are wheat, maize, beans, rice, cotton, and alfalfa.The overall land suitability map for the crop production was produced based on three layers of physical, chemical and fertility qualities. The weighted overlay process was applied to different thematic layers. The results of the soil suitability classification as shown in Figure 7 indicate that, the most units fall under the moderately suitable class (S2) which represents **54.76**% of the total area (**52193**ha.). The highly suitable class (S1) represents **5.05**% of the total area (**4813**ha.). About **30.93**% of the study area (**29476**ha.) was marginally class (S3) and those areas have adverse physical and chemical properties of the soil.

Table 7. Land Suitability classification for the investigated area.

Land Suitability class	Area in ha.	Area (%)
S1	**4813**	**5.05**
S2	**52193**	**54.76**
S3	**29476**	**30.93**
Fish Bonds	**222**	**0.23**
Urban	**8607**	**9.03**
Total area	**95311**	**100.00**

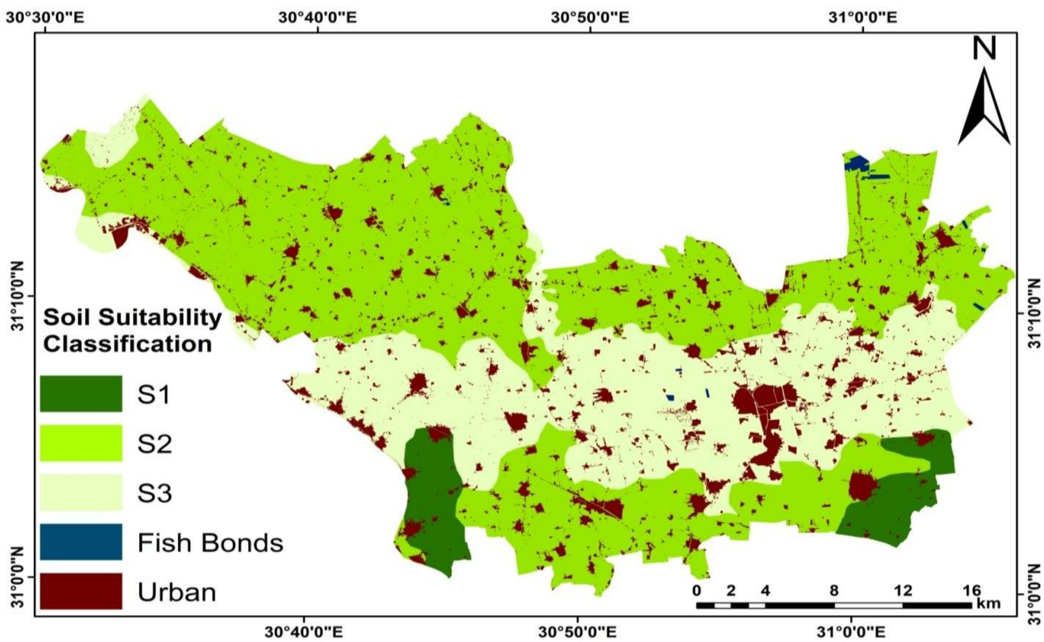

Fig. 7: Lsnd Suitability classes

Conclusions

Based on the analysis of the soil and the study of the fertility and productive capacity of the land, it is preferable to use an agricultural cycle to obtain the highest yield of the crop and maintain the fertility of the soil. Prefer farming with the appropriate types of agricultural crops proposed for the area in order to maximize agricultural production and economic return from them. Agricultural holding affects agriculture and agricultural production, and it is closely related to the prevailing type of soil and its degree of production, as well as to the state of irrigation and drainage, and the human factor is the most important control affecting the average agricultural holding. The study recommends that agricultural mechanization has a role in horizontal and vertical agricultural development processes, a new agricultural speed, while increasing production costs, reducing its costs, and starting agricultural operations. The irrigation network and its adequacy are among the factors affecting agriculture and the composition of crops in the region, on which the productivity of agricultural land depends. Agricultural drainage and its system are the most important factors that determine agricultural production, in order to rid the soil of water and excess salts.

References

AbdelRahman M. A. E, and Tahoun, S. 2018. GIS model-builder based on comprehensive geostatistical approach to assess soil quality.*Remote Sensing Applications: Society and Environment***.,**Volume 13, January 2019, Pages 204-2014..https://doi.org/10.1016/j.rsase.2018.10.012

AbdelRahman M.A. E. Adel Shalaby and Essa · E. F. 2018. Quantitative land evaluation based on fuzzy-multi-criteria spatial model for sustainable land-use planning Modeling Earth Systems and Environment (2018) 4:1341–1353 https://doi.org/10.1007/s40808-018-0478-1

AbdelRahman Mohamed AE, Natarajan A, Srinivasamurthy CA, RajendraHegde and Prakash S. S. 2018. "Assessment of Soil Quality by Using Remote Sensing and GIS Techniques; A Case study, Chamrajanagar District, Karnataka, India", Acta Scientific Agriculture, Vol. 2 No. (1) January 2018. [Citation:Mohamed AE AbdelRahman., et al. "Assessment of Soil Quality by Using Remote Sensing and GIS Techniques; A Case study, Chamrajanagar District, Karnataka, India". Acta Scientific Agriculture 2.1 (2018): 05-12.].

AbdelRahman, M.A.E., Arafat, S.M. 2020. An Approach of Agricultural Courses for Soil Conservation Based on Crop Soil Suitability Using Geomatics. Earth Sits Environ., 4: 273–285.

AbdelRahman, M.A.E., Natarajan, A. and Hegde R. 2016a. Assessment of land suitability and capability by integrating remote sensing and GIS for agriculture in Chamarajanagar district, Karnataka, India, Egypt.*J. Remote Sensing Space Sci.* (2016), http://dx.doi.org/10.1016/j.ejrs.2016.02.001

AbdelRahman, M.A.E., Natarajan, A., C.A. Srinivasamurty and Hegde R. 2016b.

AbdelRahman, M.A.E., Tahoun, S, 2019. GIS model-builder based on comprehensive geostatistical approach to assess soil quality. Remote Sensing Applications: Society and Environment., 13: 204-214.

AbdelRahman, M.A.E.; Shalaby, A.; Mohamed, E.S, 2018. Comparison of two soil quality indices using two methods based on geographic information system. Egypt. J. Remote Sensing Space Sci., 22(2): 127-136.

Ahmed, M.A.E., 2016. Land evaluation of Gharb El-Mawhob Area, El Dakhla Oasis, New Valley, Egypt. M.Sc. Thesis, Faculty of Agriculture, Assiut University, Assiut, Egypt.

Ali, R.R., Abd El-Kader, A.A., Essa, E.F., AbdelRahman, M.A.E, 2019. Application of Remote Sensing to Determine Spatial Changes in Soil Properties and Wheat Productivity Under Salinity Stress. Plant Archives, 19(1): 616-621.

Andrews, S. S., Flora, C. B., Mitchell, J. P., and Karlen, D.L. 2003. Growers' perceptions and acceptance of soil quality indinces. Geoderma, 114:187-213.

Bagherzadeh, A. and Daneshvar, M.R. 2014. Qualitative land suitability evaluation for wheat and barley crops in Khorasan-Razavi province, northeast of Iran. J. Agric. Res., 3: 155–164.

Bandyopadhyay, P. C. 2007. Soil analysis.286 p. Hardcover. CAPMAS. 2012. Egypt in figures, 2012. 1st Quarter Report, Central Agency for Public Mobilization and Statistics (CAPMAS). Cairo, Egypt.

Darwish, Kh., M. and Abdel Kawy, W,A, 2008. Quantitive assessment of soil degradation in some areas North Nile Delta, Egypt. Int J Geol., 2(2):17–22.

Dent, D. 1993. The evaluation of land resources. Journal of Rural Studies, 9 (Second), 106. https://doi.org/10.

Dobos, E., Micheli, E., Baumgardner, M. F., Biehl, L. and Helt, T. 2000. Use of combined digital elevation model and satellite radiometric data for regional soil mapping. Geoderma, 97: 367-391.

Dumanski, J., Bindraban, P. S., Pettapiece, W. W., Bullock, P., Jones, R. J. A. and Thomasson, A. 2010. Land classification, sustainable land management, and ecosystem health. Interdisciplinary and Sustainability Issues in Food and Agriculture, 3: 244-266.

Estimating soil fertility status in physically degraded land using GIS and remote sensing techniques in Chamarajanagar district, Karnataka, India. Egypt. *J. Remote Sensing Space Sci.*, http://dx.doi.org/10.1016/j.ejrs.2015.12.002

FAO. 2005. The importance of soil organic matter: Key to drought-resistant soil and sustained food production. Soils Bulletin 80, Food and Agriculture Organization (FAO). Rome, Italy.

FAO. 2006. Guidelines for Soil Description.4th ed. Rome, Italy.

Hamza, w., and Mason, S. 2004. Water availability and food security challenges in Egypt. International Forum on Food Security UnderUnder Water Scarcity in the Middle East: Problems and Solutions, Como, Italy, 24-27 Nov. 2004.

Mohana, P., Mariappan, N. V. E. and Manoharan, N. 2009. Land suitability analysis for the part of ParambikulamAliyar command area, UdumalpetTaluk using remote sensing and GIS techniques. International Journal on Design and Manufacturing Technologies, 3 (2): 98–102.

Mukashema, A. 2007. *Mapping and Modelling Landscape-based Soil Fertility Change in relation to Human Induction*. Unpublished MSc thesis. School of Natural Resource Management, ITC.

Shalaby, A., AbdelRahman, M.A.E., and Belal, A. A, 2017. A GIS Based Model for Land Evaluation Mapping: A Case Study North Delta Egypt. Egypt. J. Soil Sci., 57 (3): 339 – 351.

Taghizadeh-Mehrjardi, R., Nabiollahi, K., Rasoli, L., Kerry, R. and Scholten, T. 2020. Land suitability assessment and agricultural production sustainability using machine learning models. Agronomy, 10 (573):1-20.

USDA. 2014. Keys to soil taxonomy, 12th ed. USDA Natural Resources Conservation Service, United State Department of Agriculture (USDA), Washington, DC., 372 pp.

Verheye, W. 2008. Land evaluation. In land use and land cover (II). Belgium: UNESCO-EOLSS, Ghent University Library.

تقييم خصوبه التربه وملاءمتها لبعض المحاصيل بإستخدام نظم المعلومات الجغرافيه والاستشعار عن بعد

صفاء فتح الله محمد القط [1] ،هبه شوقى عبدالله راشد[1] ،مها محمد السيد[1] ،عادل عبدالحميد شلبى[2] ومحمد عبدالرحمن السيد عبد الرحمن[2]
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تبلغ مساحة منطقة الدراسة حوالي 95311 هكتار وتمثل أراضى دلتا النيل,حيث تم دراسه مؤشرات خصوبة التربة وملائمتها وقدرتها , وتشمل المنطقة مراكز كفر الشيخ ,دسوق,قلين,فوةوتتبع محافظه كفر الشيخ, وتقع بين خطى طول30 300 الي 310 02 شرقا وبين دائرتى العرض 31 درجة الي 3120 تم تصنيف التربه طبقا لنظام التقسيم الامريكى حتى مستوى المجموعات الكبرى أوضحت نتائج مؤشر الخصوبه SFIأن 34.95%,45.13%,6%،5.20%،5.46%ذات درجات صلاحية عاليةجداوعالية ومتوسطة ومنخفضةوالخصوبة علي التوالي .تشير نتائج تصنيف ملائمة التربة الي ان معظم الوحدات تقع تحت الفئة المتوسطة (S2) التى تمثل 45.76% من المساحة الاجمالية (52193 هكتار) وتمثل الاراضي الهامشية حوالي 30.93% اي مساحة (29476)هكتار كانت وهذه المناطق لها خواص فيزيائية وكيمائية منخفضة الجودة وجد ان المنطقة مناسبة للمحاصيل الحقلية واظهرت الدراسة ان العوامل الطبيعية والبشرية كان لها تاثير واضح علي صلاحية المحاصيل في منطقة الدراسة ايضا وجد ان الظروف المناخية المناسبة لجميع المحاصيل.